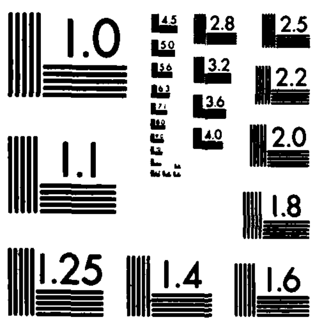
AD-A125 833 TECHNICAL MANUAL FOR CONTINUOUS FLOW LHE4 CRYOPUMP JN 2977(U) JANIS RESEARCH CO INC STONEHAM MA J D RAMSDEN 19 DEC 82 AFGL-TR-82-0395 F19628-82-C-0071 1/1

UNCLASSIFIED F/G 20/12 NL

M-2



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER AFGL-TR-82-0395	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) TECHNICAL MANUAL FOR CONTINUOUS FLOW LHe^4 CRYOPUMP J.N. 2977	5. TYPE OF REPORT & PERIOD COVERED Final Report March 1982 - December 1982
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) John D. Ramsden	8. CONTRACT OR GRANT NUMBER(s) F19628-82-C-0071
9. PERFORMING ORGANIZATION NAME AND ADDRESS Janis Research Co., Inc. 22 Spencer Street Stoneham, Massachusetts 02180	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62101F 668703AP
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Geophysics Laboratory Hanscom AFB, Massachusetts 01731 Monitor/A.D.Bailey/LKD	12. REPORT DATE December 19, 1982
	13. NUMBER OF PAGES 21
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Condensation Cryopump, Continuous Flow, Liquid Helium, Liquid Nitrogen, Vacuum, Transfer Line, Storage Dewar, Cryogens, Liquid Helium Level Meter, Solenoid Valve, Altitude Compensated Pressure Relief, Activated Charcoal Cryopanels.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report concerns the operation and maintenance of the liquid helium condensation cryopump system built for and in collaboration with the Air Force Geophysics Laboratory at Hanscom AFB. The first section briefly describes the theory of operation and discusses the precautions that should be taken when using the system. The second section describes the system and assembly procedures. The third section explains how to use the storage dewar. The fourth section describes the operating procedure of the cryopump. In the fifth section troubleshooting and maintenance procedures are explained. (over)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20 ABSTRACT

All relevant drawings and tables are included in the sixth and last section.

TABLE OF CONTENTS

I.) INTRODUCTION

The system is a liquid helium cooled condensation cryopump. It works on the priciple of creating a vacuum by condensing the gases that strike the cold surface. Also included in the system are activated charcoal cryopanels to aid in the pumping of the gases that condense at the lower temperatures (helium and hydrogen).

The cryogens being used are extremely cold and there are a number precautions that should be taken and hazards to keep in mind. The principle cryogen to be used will be liquid helium which boils at 4.2 K (-452°F). For precooling liquid nitrogen will be used; this boils at 77 K (-320°F). Because of this extreme cold there is the possibility of freezing injuries similar to burns if part of the body comes in contact with the cold gases or cold metal. It is therefore strongly recommended that loose fitting gloves and safety glasses be worn when handling these liquids. Another hazard is that because of the low temperatures air will condense and solidify. Though this is what is supposed to happen on the cold surface of the cryopump it is in no way restricted to just that area if care is not taken. Care should always be taken not to allow air to be sucked into any of the cold passages as it will freeze and block the passages. This is done by always having a positive pressure of the cryogen in the given space, only having a single open vent or check valves on the venting system, and purging all lines with gaseous helium before cooling them.

An idea that should always be kept in mind is that small amounts of liquid become large amounts of gas. This system has been provided with adequate venting, but still care should be taken not to block off these vents either by allowing them to freeze up or mechanically sealing them up.

Lastly, neither helium nor nitrogen is life supporting. On a system of this size one should not have to be too concerned about this, but some consideration might be given to adequate ventilation. Neither gas is toxic.

II.) THE SYSTEM

The system consist of five pieces; a MVE storage dewar, a vacuum insulated transfer line, the cryopump, a Lake Shore DIGI-K temperature readout, and an AMI liquid helium level indicator. Also included are two vacuum insulated tranfer legs with Linde bayonet connections at the top.

Most components are single or two piece assemblies that are simply connected into the system. The liquid helium level probe meter connects to the feedthru at the top of the storage dewar via the provided cable and according to the pin wiring diagram. The DIGI-K temperature readout connects to the feedthru on the top of the stainless steel plate on the cryopump via the provided cable and according to the pin wiring diagram. The storage dewar consists of two parts: the dewar assembly and a header assembly which has the heater and level probe hung from it. There should be no reason to separate these two. The vacuum insulated transfer line also consists of two pieces: the line itself and a foot valve on the leg. There should be no reason to separate these either. When in operation this line will be connected into the system by inserting the foot valve side in the ½" quickconnect on the header of the storage dewar and connecting the bayonet to the helium fill port on the cryopump.

The cryopump itself is more complicated and may be taken apart to gain access to various sections. The large stainless steel plate will be used for a center of reference. On the bottom head there is an electrically isolated cover flange. This may be removed (and modified if necessary) by removing the screws to the outer head. There are two (2) access ports on the outer head to provide for additional feedthrus. The outer head maybe removed by taking out the twenty-four (24) screws attaching it to the large stainless steel plate. The outer head is oriented so that the two (2) access ports are in line with the holes in the radiation shields. At this point the highly polished aluminum radiation shields will be exposed. At the center of this is a small conical aluminum radiation shield piece that may be taken off (and modified, if necessary) via the screws attaching it to the main radiation shield. The radiation shield can be taken off by removing the screws attaching it to the copper baffle plate. There is no given orientation between this and the copper cold plate.

At this point the whole inside should be exposed. Visible should be the copper cold plate, the demountable charcoal cryppanels, the two (2) silicon diode sensors, the bottoms of the Vespel Supports, and the skimmer. The skimmer is electrically isolated from the rest of the systems and may be removed by taking out the screws. There are spacers made of Kel-F material enclosing the screws to help provide electrical isolation. The copper cold plate and the copper baffle are not detachable from the large stainless steel plate because of the liquid helium cooling line. The only thing that supports these with respect to each other are the supports. If the supports are removed some type of spacer must be inserted between the different plates so that the cooling line will not be damaged and so the spacing is maintained.

To remove the supports, first the anodized aluminum caps on the top of the support assemblies must be removed. Next take off the nut and washer that were underneath this cap. The conflat flange should be removed next. By removing the screws holding the thermal anchoring plate on and the nut and washer at the bottom of the support, the support should be free and slide easily out through the top. Remember to somehow support the plates with respect to each other during this operation.

The large 7.00" I.D. body can be taken off by removing the sixteen (16) screws attaching it to the large stainless steel flange. The chevron baffle assembly cannot be removed from the system, but the upper highly polished aluminum radiation shield can. This can be accomplished by removing the peripheral screws connecting it to the chevron baffle assembly and pushing the shield piece through the hole in the copper cold plate and out the bottom. All other pieces are rigidly attached to the stainless steel plate assembly.

Reassemble by reversing this procedure. All O-rings should be cleaned and lightly greased with high vacuum grease before reinsertion. The only parts that have any orientation with respect to another part are the outer head to the radiation shield as mentioned above and the 7.00" I.D. body to the rest of the system as shown in the print.

III.) FILLING THE STORAGE DEWAR

A.) PRECOOL

To fill the storage dewar with liquid helium it must first be precooled with liquid nitrogen. It is recommended that the vacuum space of the transfer legs and transfer tube be reevacuated with a diffusion pumping system (to a pressure of about 5×10^{-5} microns) prior to use to ensure a good vacuum. The storage dewar can be precooled by doing the following:

With the header piece in place and all the vents open, including the cap off the CGA vent fitting, insert either the long initial transfer leg or a ½" O.D. stainless steel tube to about one half (½") inch above the bottom of the reservoir (to allow passage of the liquid). This will be the avenue that the liquid nitrogen will be taking into the container. It is important that the lower end of the tube be near the bottom so as to enable the cold exiting gas to cool the upper portions of the reservoir.

Connect the liquid nitrogen source to the tube or transfer leg. Fill the vessel to about 10-20% of full capacity. Let it sit for approximately one half hour (½) to allow everything to come to equilibrium at liquid nitrogen temperature. All vent valves should be closed while the dewar is coming into equilibrium. Any overpressure will vent through the Tavco pressure relief on the header. If the outside of the dewar sweats or starts to frost up, the storage dewar vacuum is bad. The dewar will have to be returned to the factory for repair.

After things are at liquid nitrogen temperature, the liquid nitrogen will have to be extracted. This should be done with the initial fill tube just off the bottom. The container should be pressurized with gaseous helium through the CGA type fitting to approximately 4 psig. The valve on this connection should be opened. All other vents should be closed. The liquid nitrogen should start coming out the top of the tube. This can be either collected for use later or just blown out into the environment. All the liquid nitrogen has to be blown out because if any is left in the dewar, an exorbinant amount of liquid helium will be used to cool it. Eventually the liquid will stop coming out and all that should be seen is a white vapor. At this point the tube should be pressed all the way to the reservoir bottom to make sure all the liquid nitrogen is out. When the vapor rises rather then falls, gaseous helium is coming out. (Cold helium gas is lighter than air, cold nitrogen gas is heavier than air). Now turn off the gaseous helium source and cap all access ports to the reservoir to prevent air from being sucked in.

The dewar should now be ready for transfering helium into it.

B.) INITIAL TRANSFER

At this point the liquid helium level probe meter should be connected. The longer vacuum jacketed helium transfer leg should be inserted to about one half (½) inch above the bottom of the reservoir. Gaseous helium should be blown through this leg prior to insertion to ensure all the air is out if the leg was not used in process of blowing out the liquid nitrogen. The liquid helium source should be started. When liquid helium starts coming out of the transfer line, insert it in the Linde bayonet connection at the top of the vacuum jacketed transfer leg. All vents should now be opened. A recommended overpressure for the delivery system is between 8 and 12 ounces/square inch. However, this will depend on the given set up. The transfer should be slow at first in order to make maximum use of the cold helium gas. When liquid helium starts to collect in the bottom of the reservoir the transfer should be quickened some. The progress of the transfer can be monitered on the liquid helium level meter. Initially this should be kept turned off and monitered only periodically. When helium starts to collect it can be kept on to moniter the transfer. When the transfer is started the meter will read zero or a little below. As the level probe cools prior to when liquid starts to collect, the meter needle will jump up scale some and then return to zero when the meter is turned on. When the needle jumps almost to full scale, liquid is about to collect. After this, the needle should have some non-zero reading and gradually go up as first helium starts to collect then the reservoir fills. When the meter reads 100%, the dewar is filled. Shut off the liquid helium supply. Break the Linde bayonet connection. Remove the initial transfer leg from the storage dewar and cap the quickonnect. Close all the opened vents. Turn off the level probe. The storage dewar is now ready for use in the cryopump system. As a rule the level meter should not be left on continuously at this point as there is a heater in it to enable it to function and this just adds to the heat input.

C.) REFILLING

If there is already liquid helium in the storage dewar then a slightly different process of filling it should be used. Because initially relatively warm gas (compared to liquid helium) comes out of the transfer line, it is best to have the leg of the transfer leg above the liquid helium bath to aboid blowing off any liquid helium that may be in the reservoir. A shorter transfer leg has been provided for this purpose. Again this leg should be purged with gaseous helium before it is put in place in the quickonnect. Liquid helium should be flowing out of the transfer line before it is connected to the leg via the Linde bayonet connector. At this point open all vents. When the transfer line is connected to the leg initially the liquid helium level may drop according to the level meter due to the warmer gas initially entering the system. Shortly the level should rise. When it is full, shut off the helium supply. Break the Linde bayonet connect. Remove the leg. Close all vents. Plug the quickonnect. Turn off the level meter. The storage dewar should again be ready for use.

IV OPERATING THE CRYOPUMP

A.) SET UP

The cryopump should be completely assembled with the detector and analyzer in place. A suitable flange with an evacuation valve in it may be substituted for the detector-analyzer assembly. The DIGI-K temperature readout should be hooked up according to the pin wiring diagram. The helium vent pressure regulating assembly with the strip heater should not be connected. The vacuum space of the cryopump should be well evacuated with a good diffusion pump to a pressure of 5×10^{-6} Torr or less.

B.) PRECOOLING

For reasons of economy it is recommended that the cryopump be precooled with liquid nitrogen. To do this, first purge the cooling tube in the cryopump with helium gas by connecting a helium gas source to the helium fill. Blow helium gas through the cooling tube for about five minutes to make sure just helium gas is in the tube. Check to make sure gas is coming out the helium exhaust. When this is accomplished, disconnect the gaseous helium source and in its place, connect a liquid nitrogen source. Blow liquid nitrogen through the cooling line, slowly at first then quicker as the cold plate cools. The speed of this should be determined by the velocity of the exiting gases and depends pretty much on what seems right at the time. Moniter the temperature on the DIGI-K readout. This should be gradually dropping. Continue to flow liquid nitrogen through the system until the readout reads 77 K, (liquid nitrogen temperature). By now liquid nitrogen will probably be coming out the helium vent. If not continue the flow of liquid nitrogen until it does. The radiation shield is also being cooled in this process and that too must get as cold as possible during this procedure. When all this is accomplished, disconnect the liquid nitrogen source and blow helium gas through the cooling tube. Do this until all the nitrogen (gas and liquid) is out of the system. This can be determined by the gas rising rather than falling. Continue this purging for a couple more minutes to ensure all the nitrogen is out. When this is done put caps on the fill and vent (just loosely not secured) to prevent the helium gas from escaping.

C.) OPERATION

At this point the cryopump cooling line should be filled with cold helium gas or if precooling was not chosen warm helium gas. There should be caps of some sort loosely on the fill and vent. The vacuum space should be evacuated. The storage dewar should be full of liquid helium. The transfer line should be well evacuated. Connect a helium gas source to the bayonet end of the transfer line. Open the foot valve by turning the flow valve regulator clockwise three or four times. Continue flowing gas through for three or four minutes making sure gas is coming out of the valve. After this purging is completed close the foot valve completely. With all but

C.) OPERATION - continued

one vent closed on the storage dewar, slowly insert the foot valve leg of the transfer line through the quickonnect. When the foot is down into the body of the storage dewar open the foot valve fully (about 4 turns). When this leg is to the bottom of the storage dewar and the boil off has subsided, some close the vent on the storage dewar. When liquid starts emitting from the bayonet end, remove the cap from the helium fill on cryopump and insert the bayonet in it. Clamp these together making sure you have a gasket between them, then quickly remove the cap from the vent. Pressure should start building in the storage dewar thus pushing the helium through the transfer line and the cryopump. If this does not happen, heat can be transmitted to the helium bath by putting current through the heater or turning on the level probe meter when it is hooked up. During this process the foot valve should be checked to make sure it has not frozen shut by turning the flow valve regulator a turn or so back and forth. The temperature should drop (as indicated on the DIGI-K readout) to approximately 6 K or 7 K.

When the terminal temperature is reached, the flow regulator should be throttled back until the minimum flow that will maintain the terminal temperature is obtained. To do this, close the valve slowly until the temperature of the cold plate begins to rise. Then open the valve slightly so that the cold plate drops back to the terminal temperature and remains there. When the flow valve regulator is being set it is best if the pressure in the storage dewar is at the point where the Taveo pressure relief on the storage dewar releases (about 5 psig). This will be the pressure the storage dewar will equilibrate around and thus the condition the system will be primarily running at. If the flow valve regulator is set at a lower pressure the flow will be faster than is necessary to maintain the terminal temperature and helium will be wasted.

There are a number of things that can be set so that the system needs no outside interference during a run. There will probably need to a heat input into the liquid helium bath to maintain the pressure in the storage dewar. This can be accomplished with either the heater or the level probe or both. Once established, this heat input should remain constant throughout the run. The DIGI-K has a set point which when exceeded will activate a relay switch. The solenoid valve should be connected to this so that when the set temperature is exceeded the valve will close taking the lower pressure relief out of the system and replacing it with the other higher pressure relief. This will enable pressure to build up in the storage dewar, increasing the liquid helium flow, and recooling the cold plate.

C.) OPERATION - continued

After these parameters have been ascertained, the only other thing that needs to be done to prepare for a balloon flight is to install the helium vent pressure relief with the strip heater. This goes right on the helium vent. (Do not forget the gasket). The strip heater takes 117 VAC and should be run continuously when the cryopump is being run. This heater warms the cold gases coming out of the cryopump and prevents them from freezing out the altitude compensated pressure relief.

V TROUBLESHOOTING AND MAINTENANCE

This section covers some difficulties that may occur. It is assumed that the operator has read the preceding sections and is familiar with the equipment.

A.) MAINTENANCE

Except for reevacuation of the transfer line and the initial and final fill tubes there is no normal maintenance required.

B.) PROBLEMS - No Flow and No Cooling

The usual cause is freezing air inside the system. Remove the transfer line withdrawal tube from the storage dewar and allow the tube to warm. Attach the helium gas hose to the helium vent tube; open the flow regulator knob and purge the system thoroughly. Helium gas will exit at the liquid helium valve.

Flow and No Cooling

If sufficient time has passed to begin cooling, check the vacuum integrity of the transfer line; re-evacuate if necessary. If the vacuum of the transfer line is "good", check the vacuum in the cryopump.

Cryopump Condenses Water on Outer Surface

If the cryopump "sweats", check the vacuum integrity of the shroud.

Unable to Turn Control Knobs

If the displacer or valve control knob cannot be rotated, the most likely course is frozen air in the system. The system should be returned to room temperature. Retest knobs for rotation, after warming. Purge the line thorougly with helium gas. A vacuum pump can be attached to the tube with the control knob closed. Back fill with helium gas before removing the pump.

Broken Supports

The supports will have to be removed and replaced as discussed early.

C.) TECHNICAL ASSISTANCE

The cryopump system should give many years of trouble free operation. If there are any problems or questions the cryogenic engineers at Janis will be happy to be of service.

O-RING LIST

MATERIAL - VITON

O-RING NUMBER	TYPE OF SEAL	LOCATION
2-367	Cryopump Vacuum	7" I.D. Body to Analyzer Flange
2-385	Cryopump Vacuum	Outer Head to Stainless Steel Flange
2-263	Cryopump Vacuum	7" I.D. Body to Stainless Steel Flange
2-236	Cryopump Vacuum	Cover Flange to Outer Head
2-216	Cryopump Vacuum	Cap to Conflat on Support
2-216	Cryopump Vacuum	Sensor Feedthrough
2-227	Cryopump Vacuum	Spring Load Safety Pressure Relief
2-012	Gas	Transfer Tube Leg
2-224	Gas	Header to Storage Dewar
2-024	Gas	Header Feedthrough
GK075*	Cryopump Vacuum	Mini Conflat Flanges
K150-CR**	Gas	Bayonet Fill

* MDC part number

** Stainless center ring and o-ring assembly; MDC part number

Janis RESEARCH COMPANY, INC.

PIN WIRE TABLE-LEVEL PROBE AND HEATER

CRYOSTAT SERIAL NUMBER 2977

8 PIN CONNECTOR

LOCATION: TOP OF STORAGE DEWAR

PIN A	- LEVEL SENSOR NEG. VOLTAGE (YELLOW)	-	GREEN CABLE COLOR
PIN B	- LEVEL SENSOR POS. VOLTAGE (BLUE)	-	WHITE CABLE COLOR
PIN C	- LEVEL SENSOR NEG. CURRENT (BLACK)	-	RED CABLE COLOR
PIN D	- LEVEL SENSOR POS. CURRENT (RED)	-	BLACK CABLE COLOR
PIN E	- OPEN		
PIN F	- OPEN		
PIN G	- 25 ohm Heater in Storage Dewar.		
PIN H	-		

PIN WIRING TABLE-SENSORS

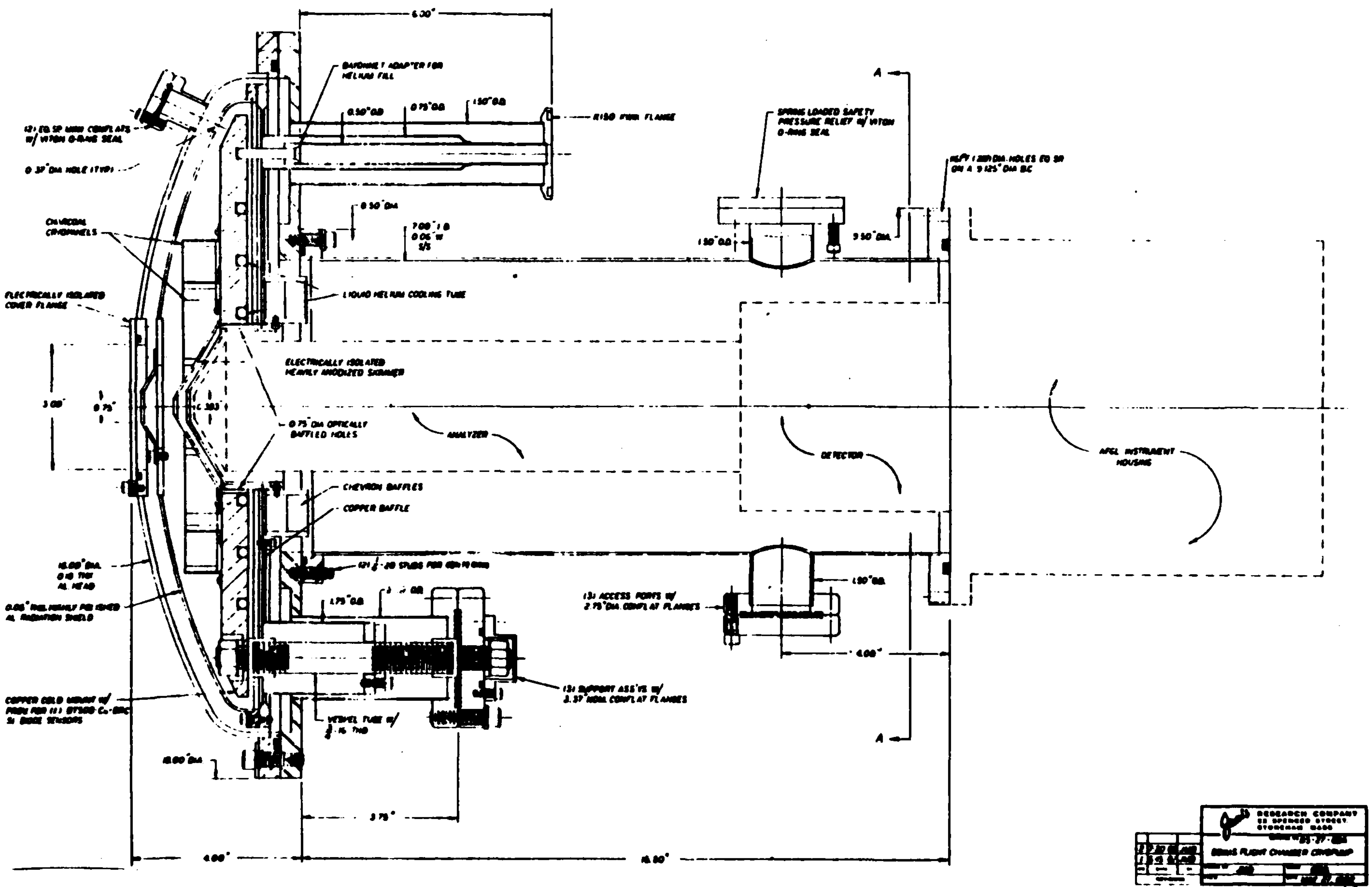
CRYOSTAT SERIAL NUMBER 2977

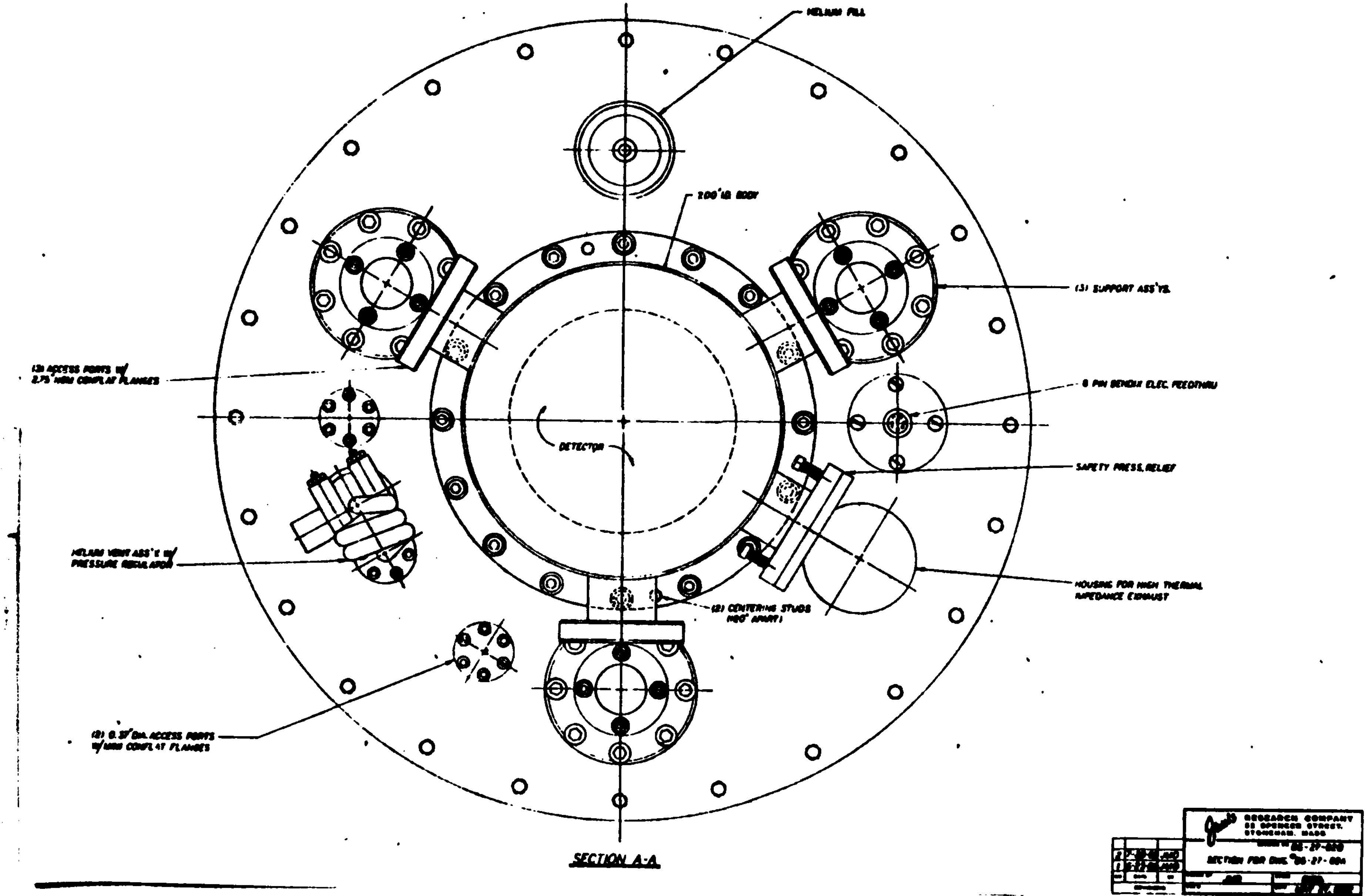
8 PIN CONNECTOR

5 PIN CONNECTOR ON DIGI-K/READOUT

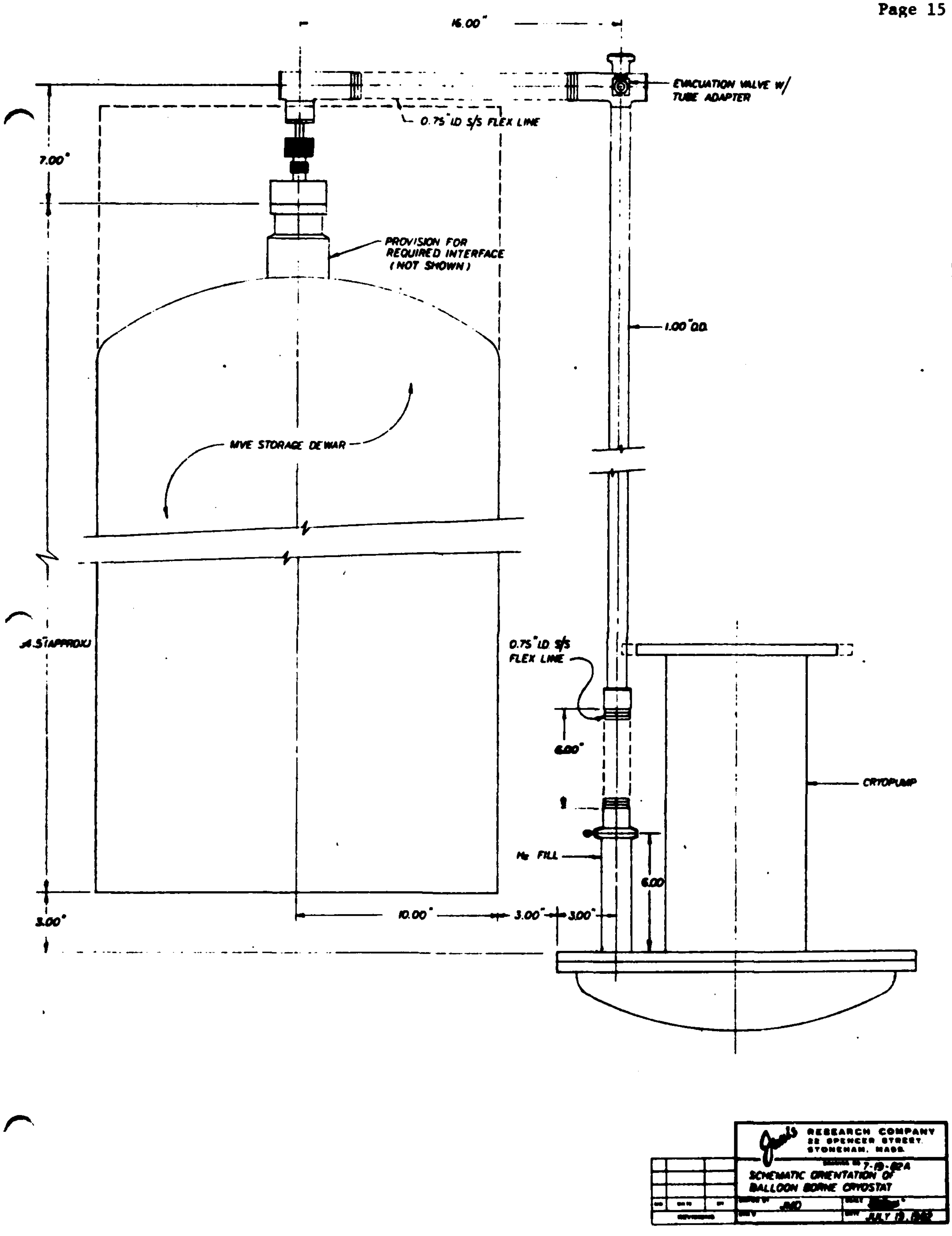
LOCATION: INTERMEDIATE FLANGE

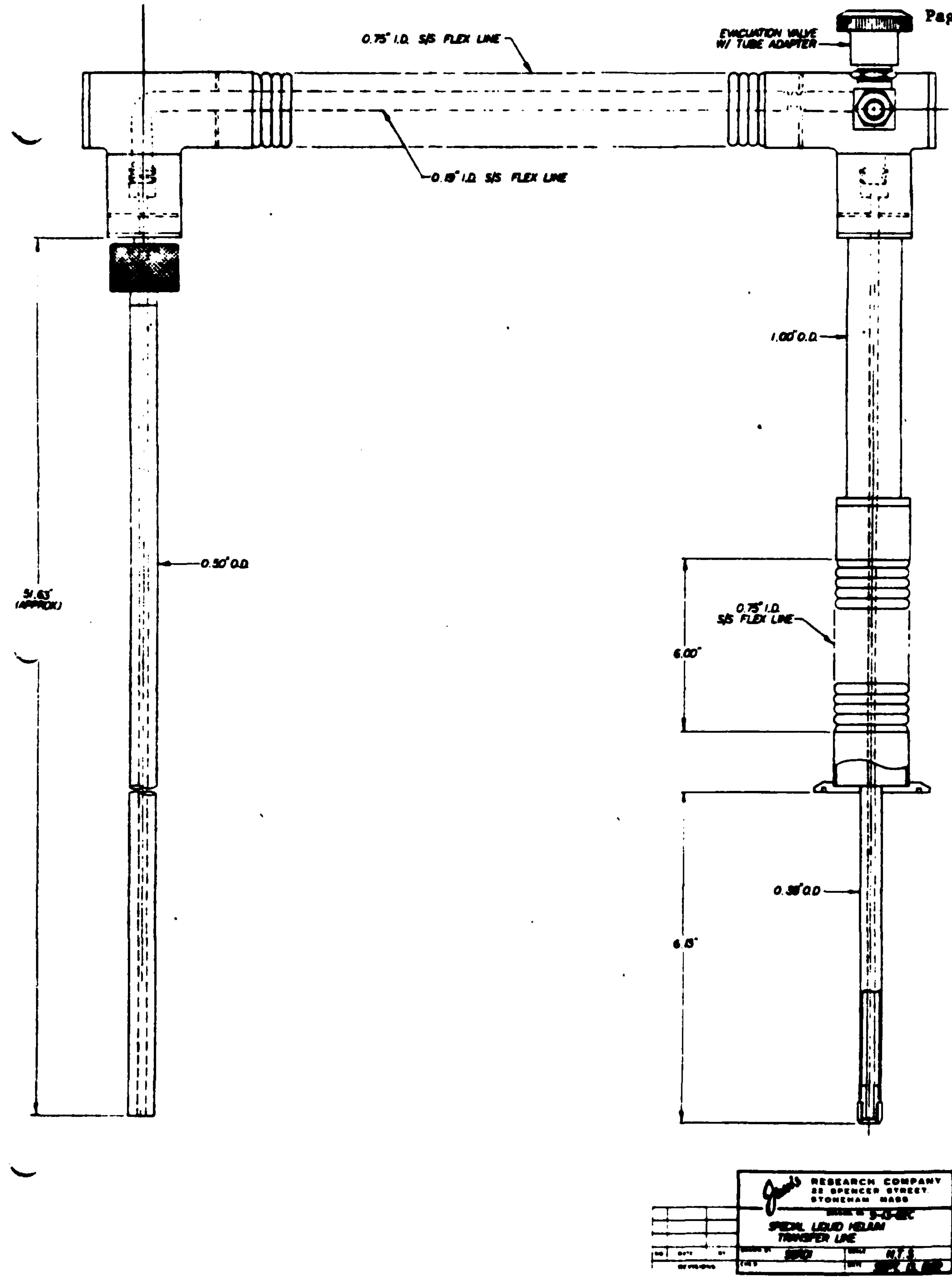
PIN	A	-	POS. VOLTAGE	-	Si DIODE ANODE	-	PIN	A	-	READOUT
PIN	B	-	POS. CURRENT	-	Si DIODE ANODE	-	PIN	E	-	READOUT
PIN	C	-	NEG. CURRENT	-	Si DIODE CATHODE	-	PIN	B	-	READOUT
PIN	D	-	NEG. VOLTAGE	-	Si DIODE CATHODE	-	PIN	D	-	READOUT
PIN	E	-	RED WIRE	-	POS. VOLTAGE	-	Si DIODE ANODE			
PIN	F	-	BLACK WIRE	-	POS. CURRENT	-	Si DIODE ANODE			
PIN	G	-	GREEN WIRE	-	NEG. CURRENT	-	Si DIODE CATHODE			
PIN	H	-	WHITE WIRE	-	NEG. VOLTAGE	-	Si DIODE CATHODE			


6.00"
BAYONET ADAPTER FOR HELIUM FILL
0.50" O.D.
0.75" O.D.
1.50" O.D.
R150 PUMP FLANGE
(2) EQ SP MINI CONFLATS W/ VITON O-RING SEAL
0.37" DIA HOLE (TYP)
CHARCOAL CRYOPANELS
0.50" DIA
7.00" I.D. 0.06" W S/S
LIQUID HELIUM COOLING TUBE
ELECTRICALLY ISOLATED COVER FLANGE
ELECTRICALLY ISOLATED HEAVILY ANODIZED SKIMMER
3.00"
0.75"
0.75" DIA OPTICALLY BAFFLED HOLES
ANALYZER
CHEVRON BAFFLES
COPPER BAFFLE
16.00" DIA 0.10 THK AL HEAD
1.75" O.D.
COPPER COLD MOUNT W/ PROV FOR (1) DT500 Cu-DRC Si DIODE SENSORS
(3) SUPPORT ASS'YS W/ 3.37" NOM CONFLAT FLANGES
VESPEL TUBE W/ 3/8-16 THD
18.00" DIA
3.75"
4.00"
16.00"
SPRING LOADED SAFETY PRESSURE RELIEF W/ VITON O-RING SEAL
1.50" O.D.
9.50" DIA
A
DETECTOR
(3) ACCESS PORTS W/ 2.75" DIA CONFLAT FLANGES
1.50" O.D.
4.00"
AFGL INSTRUMENT HOUSING
RESEARCH COMPANY
STONEHAM MASS

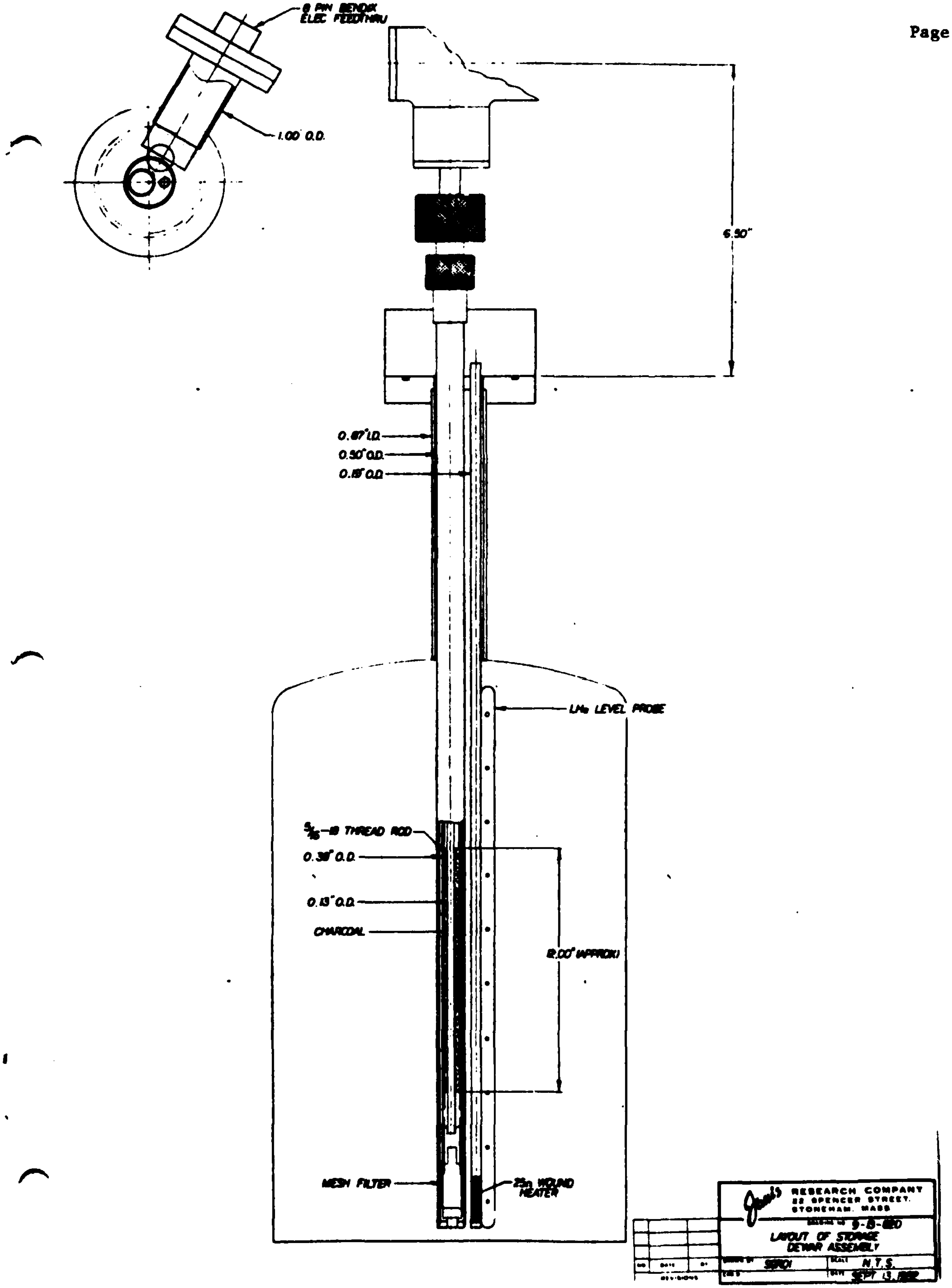

HELIUM FILL
2.00" I.D. BODY
(3) SUPPORT ASS'YS.
(3) ACCESS PORTS W/
2.75" NEW CONFLAT FLANGES
8 PIN BENDIX ELEC. FEEDTHRU
DETECTOR
SAFETY PRESS. RELIEF
HELIUM VENT ASS'Y W/
PRESSURE REGULATOR
HOUSING FOR HIGH THERMAL
IMPEDANCE EXHAUST
(2) CENTERING STUDS
180° APART
(2) 0.37" DIA. ACCESS PORTS
W/ MINI CONFLAT FLANGES
RESEARCH COMPANY
SPENCER STREET,
STONEHAM, MASS.

SECTION A-A


16.00"
EVACUATION VALVE W/
TUBE ADAPTER
0.75" I.D. S/S FLEX LINE
7.00"
PROVISION FOR
REQUIRED INTERFACE
(NOT SHOWN)
1.00" O.D.
MVE STORAGE DEWAR
0.75" I.D. S/S
FLEX LINE
6.00"
CRYOPUMP
He FILL
6.00
3.00"
10.00"
3.00"
3.00"
RESEARCH COMPANY
22 SPENCER STREET
STONEHAM, MASS.
7-19-82A
SCHEMATIC ORIENTATION OF
BALLOON BORNE CRYOSTAT
JULY 19, 1982



EVACUATION VALVE W/ TUBE ADAPTER
0.75" I.D. S/S FLEX LINE
0.15" I.D. S/S FLEX LINE
1.00" O.D.
0.50" O.D.
51.63" (APPROX.)
0.75" I.D. S/S FLEX LINE
6.00"
0.38" O.D.
6.13"
Janis RESEARCH COMPANY
22 SPENCER STREET
STONEHAM MASS
SPECIAL LIQUID HELIUM TRANSFER LINE
N.T.S.


8 PIN BENDIX ELEC FEEDTHRU
1.00 O.D.
6.50"
0.50" O.D.
LHe LEVEL PROBE
CHARCOAL
12.00" (APPROX)
MESH FILTER
RESEARCH COMPANY
STONEHAM, MASS
LAYOUT OF STORAGE DEWAR ASSEMBLY
N.T.S.